Ka-Ku: Some Science Drivers:

1) **Ka/Ku are the DPR frequencies**. Should be able to routinely and cost-effectively test with these frequencies on the ground (viewing angle issue?). Relative dearth of research ready platforms.

2) Need to extend measurements to **cover very light precipitation (0.2 mm/hr per GPM L2 requirement) and associated DSD's,** Requires something beyond S, C and even X.

3) **Need to sample ("detect"- L2 requirement) snow/ice and the ice process.**

4) **Need to sample mixed phase well!** Higher frequencies, polarimetric are better suited to this (X-Ka, and Ku-Ka should be promising for snowfall and mixed phase retrievals- if beams are matched).

5) **Ka-Ku bridge from cloud water to precip.** (potential retrieval with Ku-Ka?)- implications for GMI retrievals and DPR attenuation/DSD retrievals (evolution of DSD).

6) **Complex terrain** (higher frequency more agile platform well suited for studies in terrain where attenuation over long distances is not an issue).

7) **Portability**- we need to be able to **sample many regimes in many locations with minimal effort** (OK, E. U.S., W. U.S., overseas, at sea?). GV Radar system needs to be *easily* transported and *easily* operated (mobile truck mounted vs. container- both possibilities?).

Issues to consider:

1) **Matched or no matched beams**? S.B. retrieval-needs driven. Suggestion is that matched is preferred but how confident are we in our ability to truly match the main beam and the sidelobes?

2) **What can we do** if the Ka/Ku beams are not well matched?

3) **Do we need pol W-band**? (clouds and UT ice- especially shapes for scattering calcs.) **Passive microwave radiometer** (Meneghini and Olson have both suggest "yes" in the past)**?**

4) **Management, Maintenance, Operation (Open RFP?)**

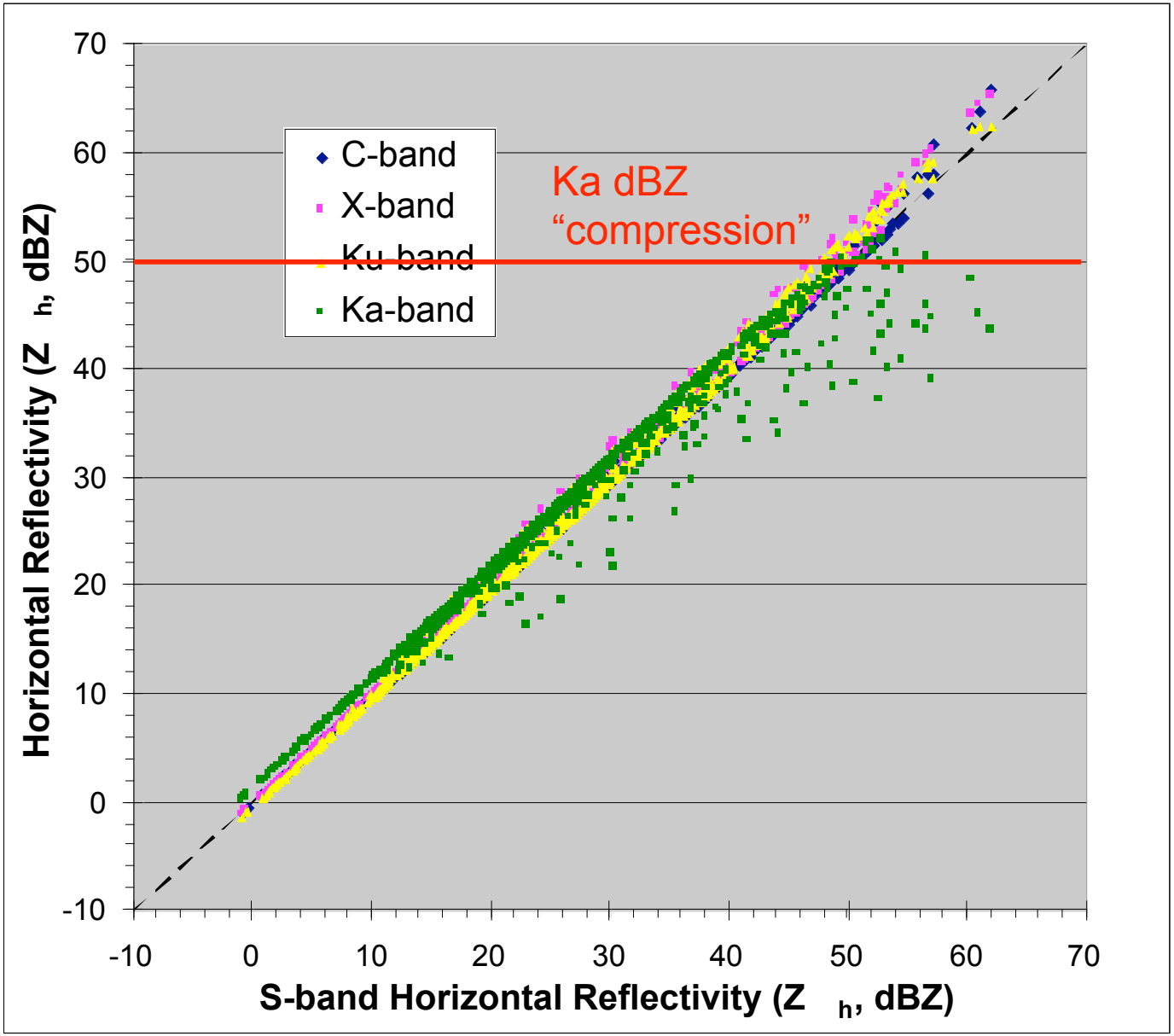
5) **MC3E: DSDs are a priority in a wide spectrum of rain rates/types.** Can this platform be ready for MC3E in 2010; should it be ready? What if it is not (i.e., how critical is it?)

Food for thought…..

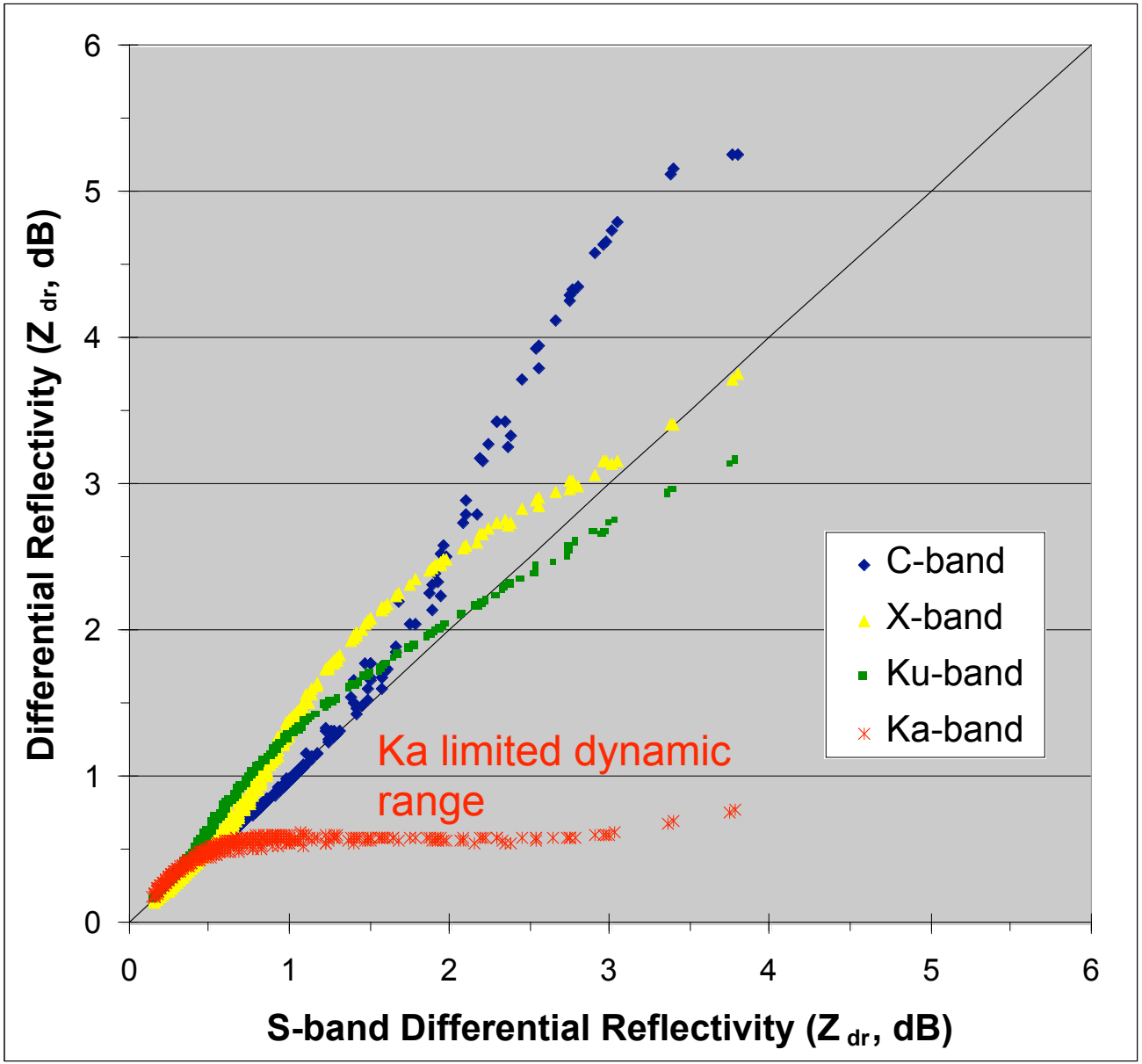
Wavelength issues- things we will have to deal with

T-matrix Scattering Simulations in Rain from S- to Ka- band

- Wavelengths: S-band (10.7 cm), C-band (5.4 cm), X-band (3.2 cm), Ku-band (2.2 cm), Ka-band (8.6 mm)
- Drop Size Distribution (DSD) – 891 one minute averages from MCTEX-95 (e.g., Carey et al. 2000, Keenan et al. 2000, Zrnic et al. 1999)
  - Dmax = 8 mm based on CPOL and video-sonde observations – highlights big drop impacts on polarimetric radar parameters.
  - Tropical Island Break Period: Hector
- Drop Shape vs. Size Relation: Andsager et al. (1999)
- Temperature: 20°C
- Fall Mode: Gaussian distribution of canting angle with 0° mean and 10° standard deviation.

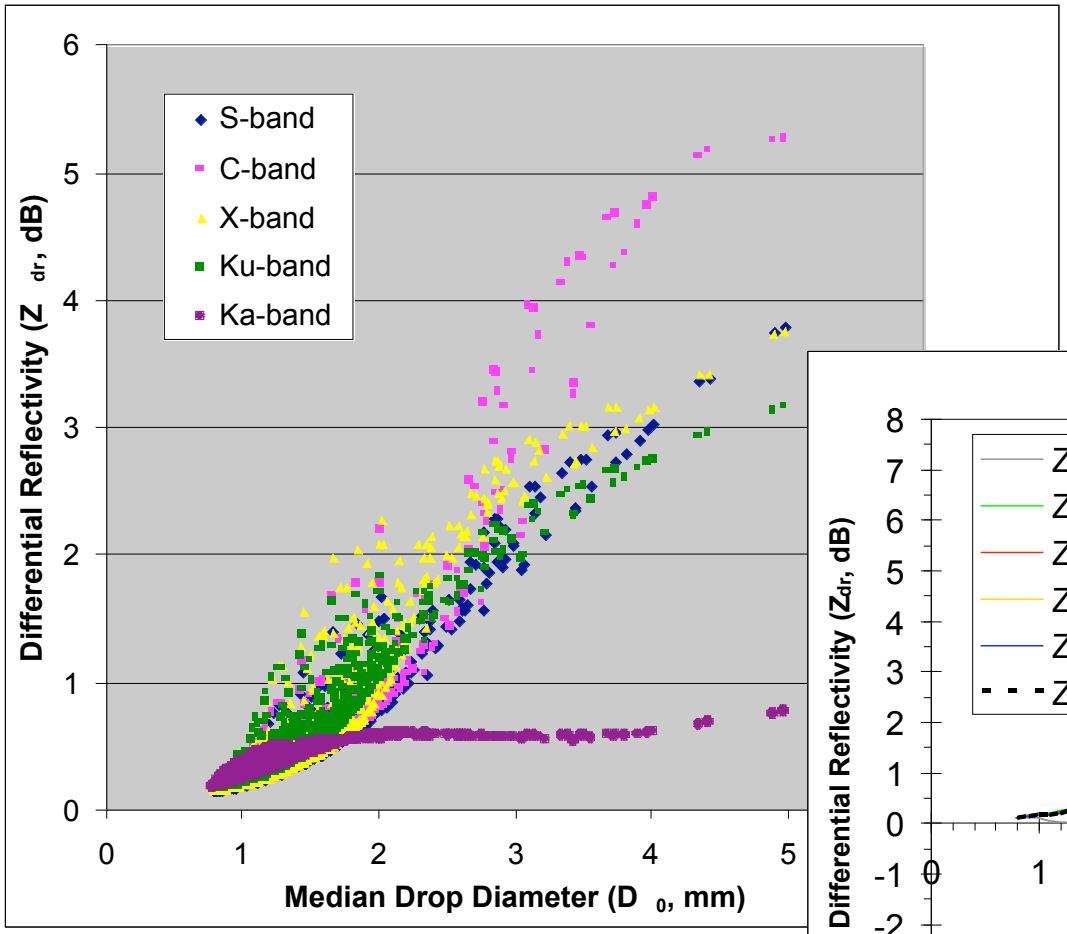


- Substantial non-Rayleigh effects on Ka-band Zh – expected reduction relative to S-band, especially at large S-band Zh but not limited to there since it is a function of D0

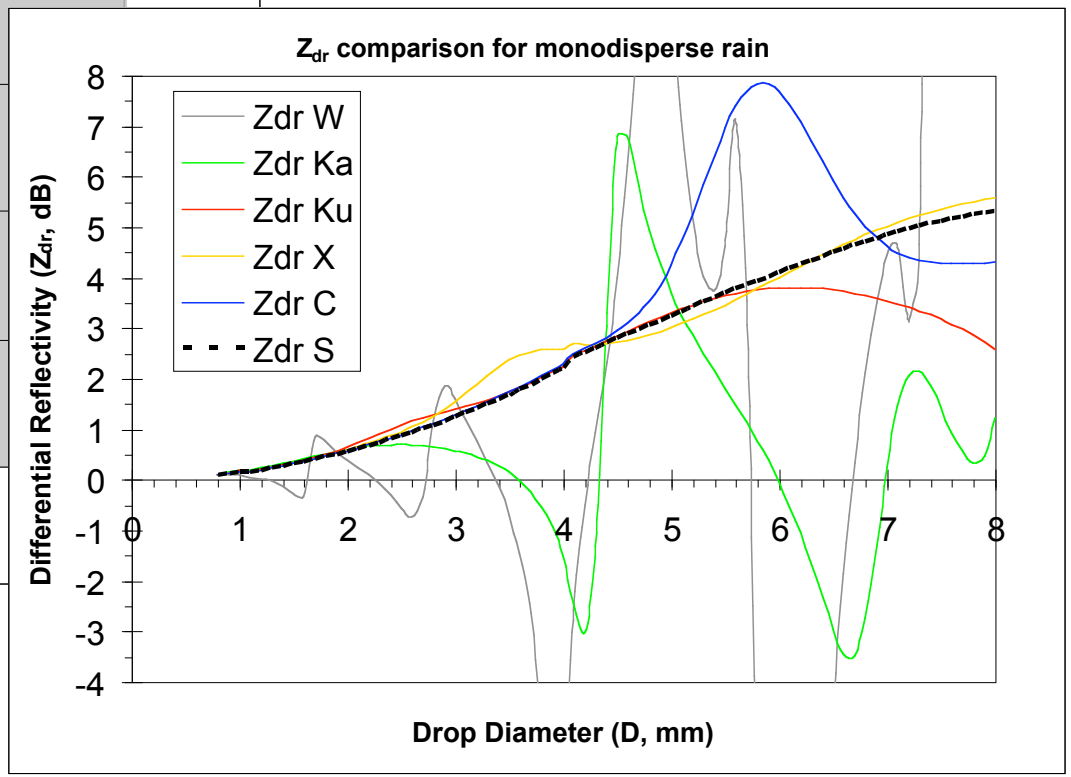


- Substantial non-Rayleigh effects on Ka-band Zdr – Ka band has small dynamic range- emphasis on lighter rain and smaller drops (exploit differences for combined algorithm?)

And as a function of D_0……

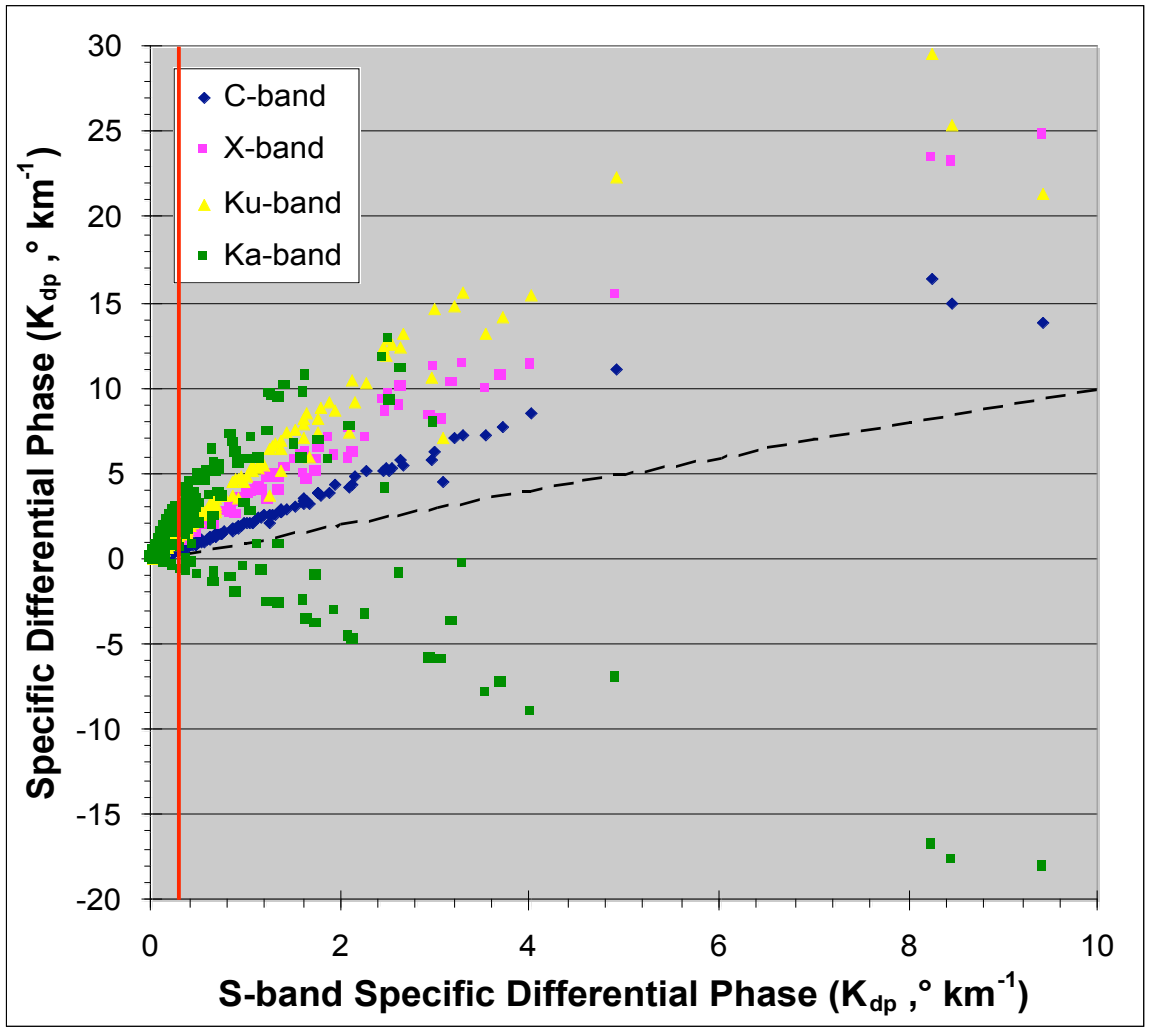


Big drop Mie impact……



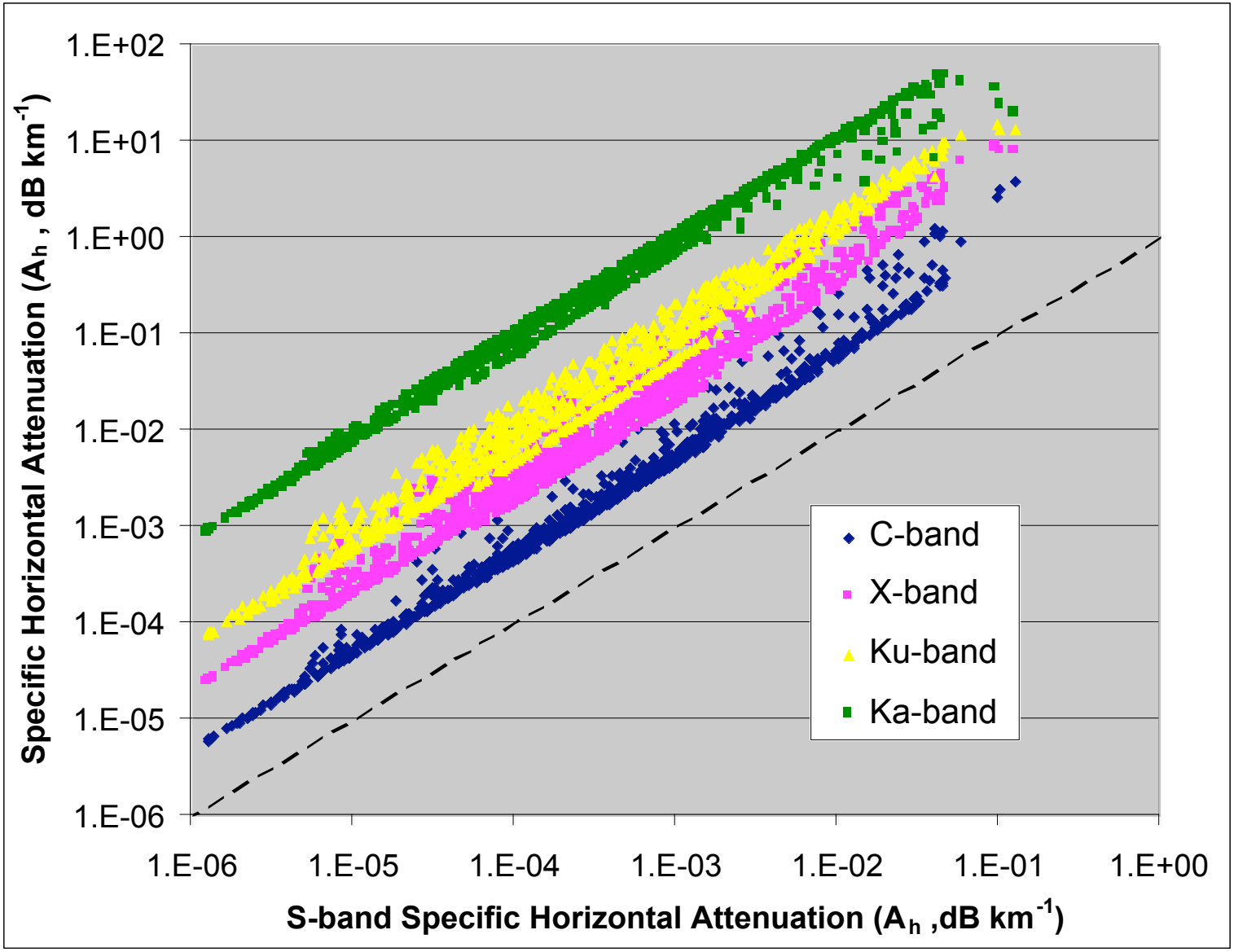
-Again, notice lack of dynamic range in Zdr for Ka-band due to **non-Rayleigh effects (big drop effect forces this)**

-Ku relatively well behaved ZDR as f(D_0) and maximum drop diameter.

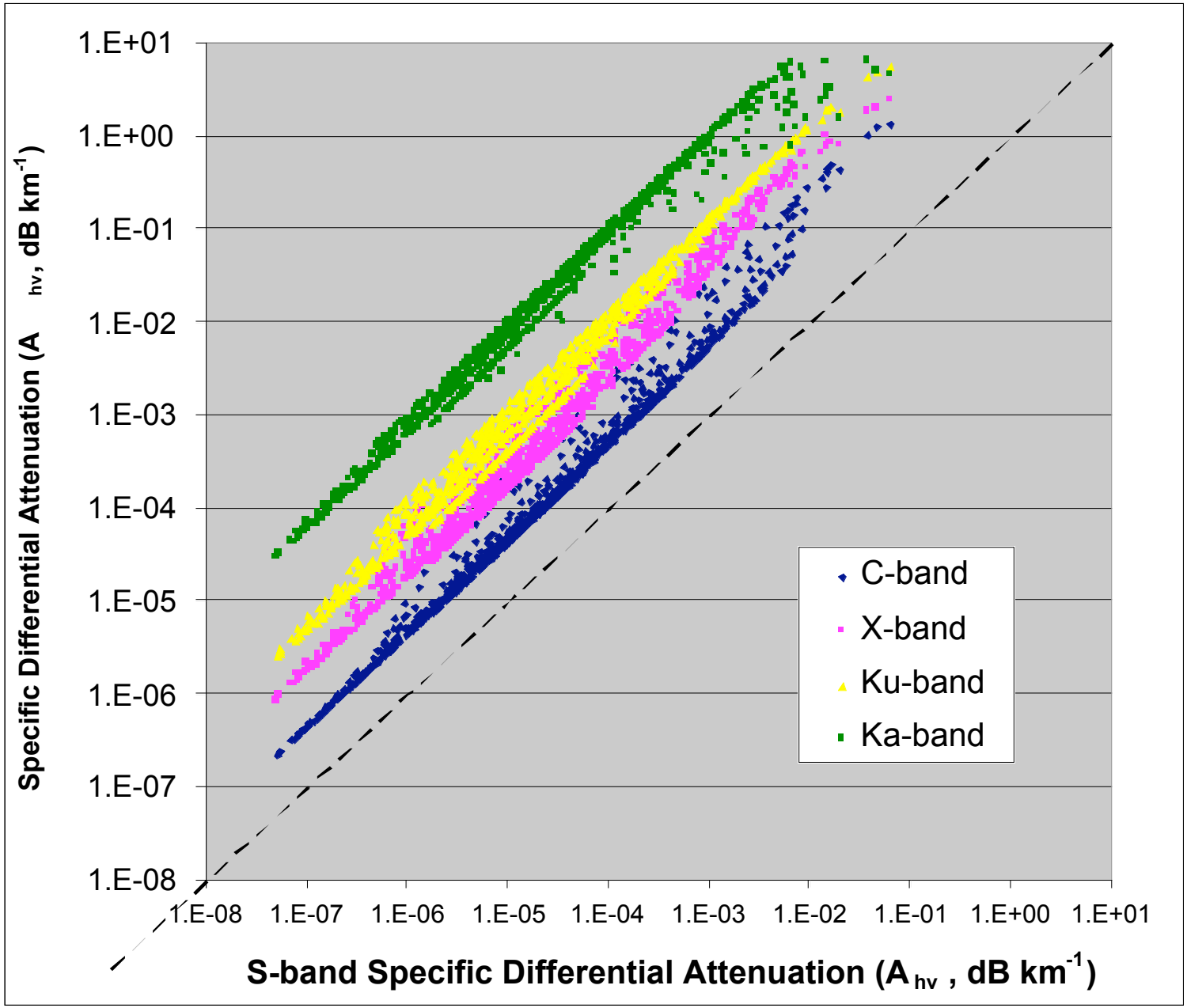


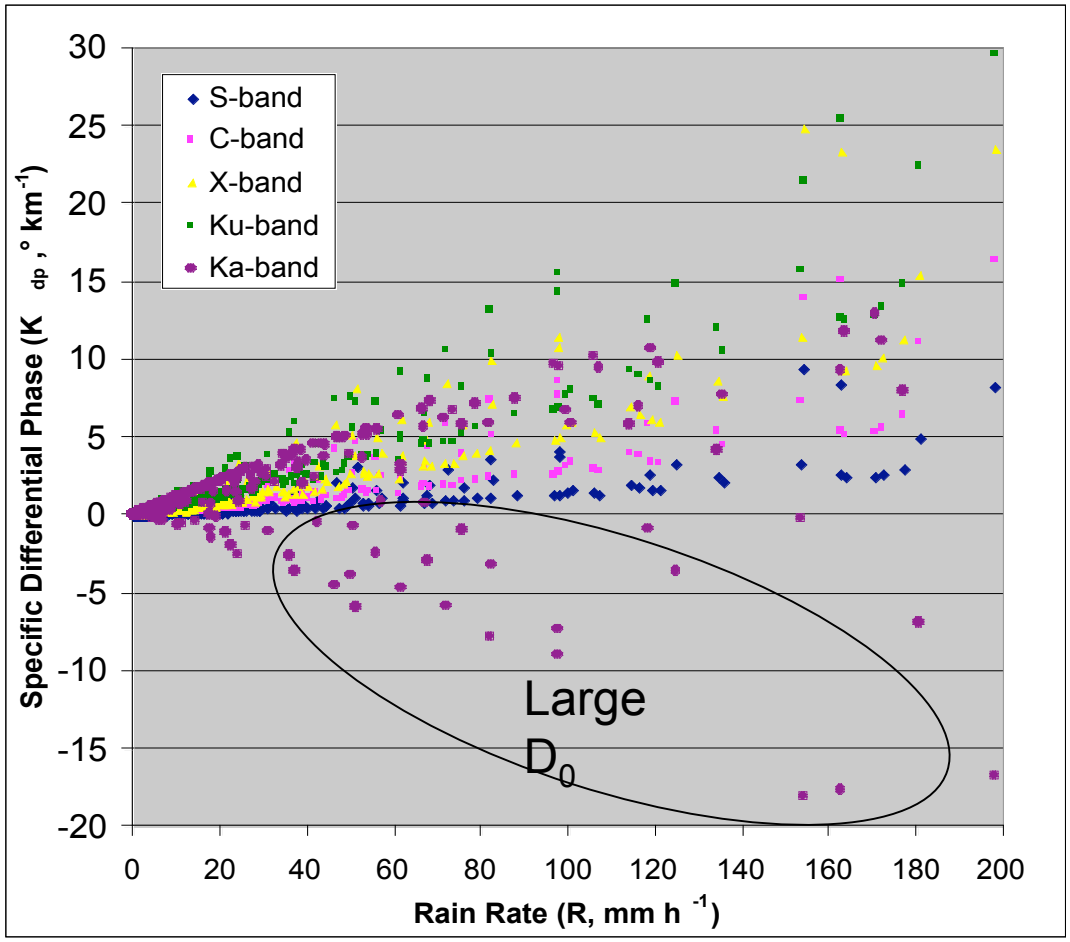
- Substantial non-Rayleigh effects on Ka-band Kdp – negative values!
- Extended range of measurement for Ku (Ka KDP is probably ok at low values- lighter precip.- as long as D0 is not too large- i.e., goes negative at D0 ~ 2 mm).

10x difference in attenuation between Ku-Ka (favorable DWR- if beams matched)



HUGE differential attenuation in Ka and significant at Ku





Use of Ka-band Kdp in rain rate estimation limited to regions that lack larger drops due to negative Kdp- though, (if the simulations are correct) what if we exploited the symmetry and used both the sgn(KDP) and |KDP|- rainrate + D0?